IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Nathan Bowman Littrell	:	
	:	Art Unit:
Serial No.: 10/827,201	:	
	:	Examiner:
Filed: April 13, 2004, according to USPTO filing receipt (correct date is April 19, 2004)	:	
	:	
For: METHODS AND APPARATUS FOR PROVIDING ALARM NOTIFICATION	:	

CERTIFICATE OF MAILING BY EXPRESS MAIL TO THE COMMISSIONER OF PATENTS AND TRADEMARKS

Express Mail label number: EL 977 940 517 US
Date of Mailing: October 8, 2004

I certify that the documents listed below:

- Certificate of mailing by Express mail to the Commissioner of Patents ad Trademarks (1 page)
- Petition to Correct Filing Date of Filed Application (2 pages, in duplicate)
- Copy of Utility Patent Application as Filed (34 page, which includes: Utility Patent Application Transmittal (1 page), Fee Transmittal (1 page), Application (19 pages), Formal Drawings (3 pages), Declaration and Power of Attorney (2 pages), Recordation Form Cover Sheet with attached Assignment (3 pages), Information Disclosure Statement (1 page) and Preliminary Amendment (4 pages))
- Copy of PTO Date Stamped Return Postcard (1 page)
- Copy of U.S. Postal Service Track & Confirm (1 page)
- Copy of facsimile from United States Postal Service confirming delivery date (1 page)
- Return Postcard

are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. §1.10 on the date indicated above in an envelope addressed to Mail Stop: Petition, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Alan L. Cassel, Reg. No.: 35,842
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(314) 621-5070

10-12-04

DAE

Express Mail No. EL 977 940 517 US

145512
PATENT

IN THE UNITED STATES OFFICE OF PATENTS AND TRADEMARKS

Applicant: Nathan Bowman Littrell

Art Unit: 2184

Serial No.: 10/827,201

Examiner:

Filed: April 13, 2004, according to USPTO filing receipt (correct date is April 19, 2004)

For: METHODS AND APPARATUS FOR PROVIDING ALARM NOTIFICATION

PETITION TO CORRECT FILING DATE OF FILED APPLICATION

Mail Stop: Petitions
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant respectfully Petition to accord a Filing Date of ***April 19, 2004***, in accordance with 37 CFR 1.10(c) for the above-referenced application.

(1) Fees: The Commissioner is hereby authorized to charge payment of any fees due or credit any overpayment to Deposit Account No. 01-2384.

(2) Submitted herewith as evidence of delivery of the above-referenced application to the United States Patent and Trademark Office on ***April 19, 2004***, are:

a. A copy of the above referenced Utility Patent Application, as filed, in our records, showing on the Certificate of Mailing via Express Mail, the Patent Application Transmittal and the Fee Transmittal showing a mailing date of ***April 19, 2004***.

b. A copy of the return postcard showing a mailing date of ***April 19, 2004***, of the above-referenced patent application.

c. A United States Postal Service Track & Confirm statement showing the acceptance Express Mail No. EL977940139US, with the U.S. Postal Service on ***April 19, 2004***.

d. A copy of a facsimile from the United States Postal Service confirming the

date of delivery Express Mail No. EL977940139US on ***April 20, 2004***.

(3) Applicants hereby request the Commissioner to accord a filing date of ***April 19, 2004***.

(4) Pursuant to MPEP 506.02, Applicant submits that no defect exists and, accordingly, requests a refund of any fees that may be charged to Deposit Account No. 01-2384.

(5) Applicant appreciates and understands that this petition is unusual in that it requests a later filing date than that accorded by the USPTO, however the petition is required because the filing date accorded by the USPTO is incorrect due to PTO and/or USPS error.

Respectfully submitted,

Oct. 8, 2004

Alan L. Cassel, Reg. No.: 35,842
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COPY Express Mail No. 977 940 517 US

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	145512
First Inventor	Nathan Bowman Littrell
Title	Methods and Apparatus for Providing Alarm Notification
Express Mail Label No.	EL 977940239 US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ Fee Transmittal Form (e.g. PTO/SB/17) *(Submit an original and a duplicate for fee processing.)*
2. ☐ Applicant claims small entity status. See 37 CFR 1.27.
3. ☒ Specification [*Total Pages* 19] *(preferred arrangement set forth below)*
   - Descriptive title of the invention
   - Cross Reference to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. ☒ Drawing(s) *(35 U.S.C. 113)* [*Total Sheets 3*]
5. Declaration & Power of Attorney [*Total Pages 2*]
   a. ☒ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37 CFR 1.63 (d)) *(for continuation/divisional with Box 17 completed)*
      i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. ☐ Application Data Sheet. See 37 CFR 1.76

ADDRESS TO: Mail Stop Patent Application, Commissioner for Patents, PO Box 1450, Alexandria, VA 22313-1450

7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program *(Appendix)*
8. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. ☒ Assignment Papers (cover sheet & document(s)) [3 pages]
10. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney *(when there is an assignee)*
11. ☐ English Translation Document *(if applicable)*
12. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
13. ☐ Preliminary Amendment
14. ☒ Return Postcard (MPEP 503) *(Should be specifically itemized)*
15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. ☐ Non Publication Request under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. ☒ Other: Preliminary Amendment (4 pages)

18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:*

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: /

Prior application information: *Examiner* _____ *Group Art Unit:* _____

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

19. CORRESPONDENCE ADDRESS

☐ *Customer Number or Bar Code Label* *(Insert Customer No. or Attach bar code label here)* or ☒ *Correspondence address below*

Name	**John S. Beulick**				
	Armstrong Teasdale LLP				
Address	**One Metropolitan Square, Suite 2600**				
City	**St. Louis**	*State*	**MO**	*Zip Code*	**63102**
Country	**US**	*Telephone*	**314.621.5070**	*Fax*	**314.621.5065**
Name (Print/Type)	Alan L. Cassel	*Registration No. (Attorney/Agent)*			35,842
Signature	Alan Cassel			*Date*	April 19, 2004

Certificate of Express Mail

I certify that the documents listed on this form are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above in an envelope addressed to: Mail Stop Patent Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Alan L. Cassel	Alan Cassel	April 19, 2004
(Printed Name of Person Mailing Correspondence)	*(Signature of Person Mailing Correspondence)*	Date

Express Mail No. EL 977940239 US

PTO/SB/17 (10-03)
Approved for use through 07/31/2006. OMB 0651-0032
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 1,518.00

Complete if Known	
Application Number	
Filing Date	April 19, 2004
First Named Inventor	Nathan Bowman Littrell
Examiner Name	
Art Unit	
Attorney Docket No.	145512

METHOD OF PAYMENT *(check all that apply)*

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☑ Deposit Account:

Deposit Account Number: 01-2384

Deposit Account Name: Armstrong Teasdale LLP

The Director is authorized to: *(check all that apply)*

☑ Charge fee(s) indicated below ☑ Credit any overpayments

☑ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, **except for the filing fee** to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	770.00
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($) 770.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

		Extra Claims		Fee from below	Fee Paid
Total Claims	45	-20** =	25	x 18.	= 450
Independent Claims	6	- 3** =	3	x 86.	= 258
Multiple Dependent					=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 708.00

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	40.00
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 40.00

SUBMITTED BY

Name (Print/Type)	Alan L. Cassel	Registration No. (Attorney/Agent)	35,842	Telephone	314-621-5070
Signature	Alan Cassel			Date	April19, 2004

(Complete *(if applicable)*)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

This collection of information is required by 37 CFR 1.17 and 1.27. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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METHODS AND APPARATUS FOR PROVIDING ALARM NOTIFICATION

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to methods and apparatus that provide automatic notification of machine malfunctions.

[0002] Operators of significant equipment or processes need warning of equipment or process malfunction. Such equipment can include machinery in power plants, oil refineries, pipeline pumping stations, manufacturing facilities, and any other appropriate applications. Known threshold-based alarms can be used, and such alarms provide an operator to use remedial tools and procedures to correct malfunction conditions. However, alarms based on parameter thresholds may not be timely enough to allow an operator to use such tools and procedures optimally in all conditions.

BRIEF DESCRIPTION OF THE INVENTION

[0003] Some configurations of the present invention therefore provide a method for indicating an alarm condition in an industrial process. The method includes measuring a parameter of the industrial process that varies over time and determining at least one parameter limit as a function of the parameter and also varying over time. The method further includes comparing the parameter to the parameter limit or limits and indicating an alarm condition when the parameter is outside of a bound set by the parameter limit or limits when the parameter is compared to the parameter limit or limits.

[0004] Also, some configurations of the present invention provide an apparatus for indicating an alarm condition in an industrial process. The apparatus includes a sensor configured to measure a parameter of the industrial process, a data acquisition system, and a computer. The apparatus is configured to measure a time-varying parameter of the industrial process and determine at least one parameter limit

that is a function of the parameter and also varies over time. The apparatus is further configured to compare the parameter to the parameter limit or limits and indicate an alarm condition when the parameter is outside a bound set by the parameter limit or limits when the parameter is compared to the parameter limit or limits.

[0005] In addition, some configurations of the present invention provide a medium having machine-readable instructions recorded thereon that are configured to instruct a computer to input a sensed, time-varying parameter of an industrial process, determine at least one parameter limit as a function of the parameter and also varying over time. The instructions also are configured to instruct a computer to compare the parameter to the parameter limit or limits, and indicate an alarm condition when the parameter is outside of a bound set by the parameter limit or limits when the parameter is compared to the parameter limit or limits.

[0006] In yet another aspect of the present invention, there is provided a method for indicating an alarm condition in an industrial process. The method includes measuring a time-varying parameter of the industrial process, latching the parameter and buffering the latched parameter in a FIFO (first-in, first-out) buffer, and determining statistical functions of values of the buffered parameter stored in the FIFO buffer. The method further includes utilizing the determined statistical functions to determine one or more alert limits, comparing value of the parameter to the one or more alert limits; and indicating an alarm dependent upon the parameter being outside a bound set by the one or more alert limits.

[0007] Furthermore, some configurations of the present invention provide an apparatus for indicating an alarm condition in an industrial process. The apparatus is configured to latch a varying parameter value of the industrial process and buffer successive latched parameter values in a FIFO (first-in, first-out) buffer, determine statistical functions of values of the buffered parameter stored in the FIFO buffer, and utilize the determined statistical functions to determine one or more alert limits. The apparatus is further configured to compare value of the parameter to the one or more alert limits, and indicate an alarm dependent upon the parameter being outside a bound set by the one or more alert limits.

[0008] Some configurations of the present invention provide a medium having recorded thereon machine-readable instructions configured to instruct a computer to latch a varying parameter value of an industrial process and buffer successive latched parameter values in a FIFO (first-in, first-out) buffer and determine statistical functions of values of the buffered parameter stored in said FIFO buffer. The instructions are also configured to instruct a computer to utilize the determined statistical functions to determine one or more alert limits, compare value of the parameter to the one or more alert limits, and indicate an alarm dependent upon the parameter being outside a bound set by the one or more alert limits.

[0009] Configurations of the present invention allow early notification in accordance with behavior that might not trip a conventional threshold based alarm system. Additionally, configurations of the present invention avoid inappropriate alarms that may occur with conventional alarm systems that are not cognizant of machine state (e.g., whether the machine is running or not).

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Figure 1 is a block diagram of an industrial process in which a configuration of the present invention is provided to indicate an alarm when a step change in a parameter is encountered.

[0011] Figure 2 is a block diagram representative of another configuration of the present invention.

[0012] Figure 3 is a drawing showing a step change in a measured parameter.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Some configurations of the present invention track a measurand (e.g., vibration magnitude or phase) and, using the measurand, generate a result or raise an alarm when one or more configurable criteria are met (e.g., a statistically defined step change of the measurand). The invention also provides one

or more time based criteria to qualify the data before raising an alarm. Some configurations permit a user to add additional preconditions to the rule to qualify data before raising an alarm. As used herein, a "measurand" is a measurable parameter of an industrial process.

[0014] In some configurations 10 of the present invention and referring to Figure 1, an industrial machine or apparatus 12 (hereinafter "machine") has an operating characteristic that is subject to alarm conditions. A non-exhaustive list of such machines 12 includes gas turbines, steam turbines, electric generators, electric motors, pumps, gearboxes, and bearings. The operating characteristic subject to alarm conditions is sensed by one or more sensors 14. A non-exhaustive list of operating conditions that can be sensed by the one or more sensors 14 include pressure, temperature, position, acceleration, velocity, power, current, and flow. Not all of these operating conditions are appropriate for each type of machine 12, but the choice of which one or more appropriate conditions are to be sensed by the one or more sensors 14 is left as a design choice. A data acquisition system 16 receives data from the one or more sensors 14. Data acquisition system 16 can comprise, for example, networked hardware, a portable data collection unit, an internal computer or controller, or a data acquisition card in a computer system. Data acquisition system 16 is networked in some configurations to a computer 18, which in some configurations, includes or otherwise has access to a database 20. Computer 18 executes a program comprising decision support software or firmware 22, which, in turn, includes a step change rule module 24. In some configurations, database 20 contains variables that can be used for adjusting the sensitivity of step change rule module 24 in accordance with the type of machine 12 being monitored and the time--varying parameter or parameters measured by sensor 14. Decision support software 22 and step change rule 24 may be provided in the form of a computer readable medium (not shown in Figure 1), such as a floppy diskette, CD-ROM, or DVD, having recorded thereon instructions configured to instruct computer 18 to perform the operations described below.

[0015] Step change rule module 24 is configured to track a "normal" variation of a parameter. A sudden change in this parameter will cause decision support software 22 to instruct computer 18 to raise an alarm indication. Alarm indication 18, in some configurations of the present invention, activates an audible or visual alarm device or a plurality or combination of alarm devices. Step change rule module 24 provides an upper and a lower bound for each parameter tracked by the one or more sensors 14. For example, one time-varying parameter is tracked utilizing limits *D* and *E* written as follows:

$$D = average(A) + B \times std\_dev(A) + C, \text{ and}$$

$$E = average(A) - B \times std\_dev(A) - C,$$

where:

A is a value associated with the parameter (for example, the parameter value itself, or a scaled and/or possibly offset value of the parameter), which in some configurations includes a sample delay;

B is a constant multiplier;

C is a constant added to prevent a width of a window of acceptance between *D* and *E* from being narrowed to zero as a result of the standard deviation of *A* approaching or equaling zero;

D is a time-varying upper acceptance limit; and

E is a time-varying lower acceptance limit; also

average(A) and *std_dev(A)* are the average value of *A* over time and a standard deviation of *A* over time, respectively.

[0016] The current (or, in some configurations, a delayed) sample *A* is compared to upper and lower limits *D* and *E*, respectively. If *A* is outside of these limits, computer 18 is instructed to raise a suitable alarm notification, such as a displayed or audible alarm. The displayed or audible alarm need not be located on

computer 18 itself, but may be an alarm raised in a portion of or throughout a manufacturing or power generation plant, for example, depending upon the nature of the parameter *A* being measured. In some configurations, parameter *A* is buffered (i.e., delayed) by a few samples so that the limits do not open up immediately in response to a step change event, thus preventing a valid alarm condition from being triggered.

[0017] In some configurations of the present invention, the value of *B* is taken to be zero, i.e., there is no standard deviation term in the expressions for *D* or *E*.

[0018] In some configurations, the constant term *C* is zero, i.e., there is no constant term in the expressions for *D* or *E*.

[0019] In some configurations, the *std_dev()* function is replaced by another statistical measure of data variation. Replacement of the *std_dev()* function is considered appropriate in case of data that is not normally distributed.

[0020] In some configurations of the present invention, the constant *B* is set to 1. Also, in some configurations of the present invention, a one-sided alarm limit is provided, i.e., only either upper limit *D* or lower limit *E* is determined and/or used and alarms raised in accordance with only the one limit. And in some configurations of the present invention the *Average()* function is replaced with another statistical variable, for example, *median()* or *mode()*.

[0021] Boundary *D* or *E*, or the combination of both, track a "normal" (in the sense of acceptable) variation of a parameter such as vibration, temperature, power output, or any of the examples of variable *A* listed above, or other parameters. Any sudden change will cause an alarm to be raised. Varying the size of a buffer used to determine averages (or other statistical variable) determines how quickly adjustment is made to level changes. Changing the value of *B* in various configurations affects the sensitivity of the alarm to individual sample variations. The constant *C* controls a minimum acceptable window size. Additionally, the sample rate

(i.e., data collection frequency) affects alarm behavior in conjunction with sample delay (or sample buffer size), as the product of the sample rate and sample buffer size determines the time period represented by data in the buffer.

[0022] Early warnings of step changes in the characteristics of machine operation can be provided with some configurations of the present invention. For example, in some configurations of the present invention, an average and standard deviation of a set of values stored in a FIFO buffer of variable (configurable) length. An upper and lower bound is determined by adding and subtracting the standard deviation to the average value of the buffer. The standard deviation value may be further modified by a multiplier depending on application. A constant is also added to the standard deviation value to prevent the tolerance window going to zero when data is steady. An alarm is generated when the incoming value is outside of the tolerance bounds described above.

[0023] Thus, in some configurations 100 of the present invention and referring to Figure 2, a parameter measurement 102 is latched by latch 104 at suitable intervals, e.g., once every four seconds, or at any other interval suitable for observing and monitoring the industrial process. Latch 104 feeds a FIFO (first-in, first-out) buffer 106, which holds a predetermined number of values of the latched parameter. For example, and not by way of limitation, some configurations of the present invention include a 20 element FIFO, which holds the last 20 latched values of the parameter. Other configurations hold a different number of latched values, and in some configurations of the present invention, the size of FIFO buffer 106 is configurable to allow tuning of the sensitivity to sudden spikes in the parameter value. (For example, a longer buffer is less sensitive to short spikes in the parameter value.) Some configurations of the present invention determine one or more statistical functions (e.g., standard deviation and average) of the latched values for each interval and provide this information to a limit module 108, which utilizes the one or more determined statistical functions to determine one or more alert limits. Module 108 may also utilize configurable inputs, as described in conjunction with the various equations disclosed above. In some configurations of the present invention, the

statistical functions and alert limits are redetermined each time a new value of the parameter is latched and shifted into buffer 106. Also, in some configurations, the statistical values are not necessarily standard deviation and mean, but may include other suitable statistical measures, such as median or mode, or another measure of parameter variance.

[0024] A value of the measured parameter is then compared to the one or more alert limits at module 110. If the parameter is outside a bound set by the one or more alert limits, an alarm may be raised by an alert signal. In some configurations, the alert signal directly controls one or more audible or visual alarm systems. In some configurations, an alarm is not raised unless a step change persists for a period of time, as determined by block 112. The length of time required for an alarm indication is configurable in some configurations of the present invention. Also, some configurations of the present invention also provide a severity level indication based on the persistence of the alarm using a severity level module 114.

[0025] In configurations in which parameter measurements are time-stamped, the time stamp information can be logged when an alarm indication is raised.

[0026] Some configurations of the present invention inhibit an alarm signal unless a sufficient number of valid samples of the parameter are held in buffer 106. Also, some configurations of the present invention utilize a value of a parameter latched by latch 104 rather than a current measurement in the test to determine whether the parameter is out of bounds.

[0027] Some configurations of the present invention do not include modules 112 and 114, in which case the "alert" signal is used to raise an alarm. Also, some configurations of the present invention do not include block 114, in which case, the signal labeled "persistence" is used to raise an alarm.

[0028] Software utilized to implement the flow chart of Figure 2 can be used in configurations of the present invention represented in Figure 1. For

example, latch 104 and buffer 106 can be considered in many configurations to comprise decision support software 22, and modules 108, 110, 112, and 114 may be considered to comprise step change rule 24. It is to be understood that the configuration represented in Figure 2 is only one of many software configurations that can be used as decision support software 22 and step change rule 24.

[0029] Figure 3 is a graph showing a step change in a parameter. Line 200 is indicative of the parameter value in Figure 3. Line 202 is indicative of the upper limit for the parameter and line 204 is indicative of the lower limit for the parameter. An alarm is raised at a time indicated at 206.

[0030] The parameter or measurand may be any quantity of interest. Secondary configurable parameters can be applied in some configurations, including, for example, the value of the multiplier for the standard deviation, the value of the constant added to the standard deviation, the size of the buffer, and the sample rate of the buffer. A logical on/off measurement is the output of the rule, corresponding to the signal that raises the alarm. In some configurations, a quantitative severity indication may also be provided and either recorded or used to modulate or otherwise vary the alarm.

[0031] Configurations of the present invention can be used to alert machine operators far in advance of developing problems. Advantageously, configurations of the present invention trigger an alarm when a parameter changes in a statistically significant way rather than after a threshold level is crossed.

[0032] Configurations of the present invention can be used to provide early warning of problems with machinery in power plants, oil refineries, pipeline pumping stations, manufacturing facilities, and any other appropriate applications. A configurable buffer length in some configurations of the present invention allows tuning of the sensitivity to sudden spikes in parameter values. Some configurations of the present invention are suitable for use in providing alarms for data collected from nuclear reactor coolant pumps and drive turbines.

[0033] While the invention has been described in terms of various specific embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the claims.

WHAT IS CLAIMED IS:

1. A method for indicating an alarm condition in an industrial process, said method comprising:

measuring a parameter of the industrial process, said parameter varying over time;

determining at least one parameter limit, said at least one parameter limit being a function of said parameter and varying over time;

comparing said parameter to said at least one parameter limit; and

indicating an alarm condition when said parameter is outside of a bound set by said at least one parameter limit at a time when said parameter is compared to said at least one parameter limit.

2. A method in accordance with Claim 1 wherein said at least one parameter limit comprises an upper limit and a lower limit.

3. A method in accordance with Claim 2 further comprising buffering said parameter and using a time-delayed value of said parameter in said comparing said parameter to said at least one parameter limit.

4. A method in accordance with Claim 3 wherein said upper limit is an average value of the parameter plus a predetermined constant multiple of a standard deviation of the parameter, and said lower limit is the average value of the parameter minus the predetermined constant multiple of the standard deviation of the parameter.

5. A method in accordance with Claim 3 wherein said upper limit is an average value of the parameter plus a predetermined first constant plus a predetermined second constant multiple of a standard deviation of the parameter, and said lower limit is the average value of the parameter minus the predetermined first constant plus the predetermined second constant multiple of the standard deviation of the parameter.

6. A method in accordance with Claim 3 wherein said upper limit is an average value of the parameter plus a predetermined constant and said lower limit is an average value of the parameter minus a predetermined constant.

7. A method in accordance with Claim 3 wherein said upper limit and said lower limit are functions of a median value of said parameter.

8. A method in accordance with Claim 3 wherein said upper limit and said lower limit are functions of a mode of sampled values of said parameter.

9. A method in accordance with Claim 1 wherein the industrial process includes at least one apparatus selected from the group consisting of a gas turbine engine, a steam turbine, an electric generator, an electric motor, a pump, a gearbox, and bearings, and said parameter is selected from the group consisting of pressure, temperature, position, acceleration, velocity, power, current, and fluid flow.

10. An apparatus for indicating an alarm condition in an industrial process, said apparatus comprising a sensor configured to measure a parameter of the industrial process, a data acquisition system, and a computer, said apparatus configured to:

measure a parameter of the industrial process, said parameter varying over time;

determine at least one parameter limit, said at least one parameter limit being a function of said parameter and varying over time;

compare said parameter to said at least one parameter limit; and

indicate an alarm condition when said parameter is outside of a bound set by said at least one parameter limit at a time when said parameter is compared to said at least one parameter limit.

11. An apparatus in accordance with Claim 10 wherein said at least one parameter limit comprises an upper limit and a lower limit.

12. An apparatus in accordance with Claim 11 further configured to buffer said parameter and using a time-delayed value of said parameter to compare said parameter to said at least one parameter limit.

13. An apparatus in accordance with Claim 12 wherein said upper limit is an average value of the parameter plus a predetermined constant multiple of a standard deviation of the parameter, and said lower limit is the average value of the parameter minus the predetermined constant multiple of the standard deviation of the parameter.

14. An apparatus in accordance with Claim 12 wherein said upper limit is an average value of the parameter plus a predetermined first constant plus a predetermined second constant multiple of a standard deviation of the parameter, and said lower limit is the average value of the parameter minus the predetermined first constant plus the predetermined second constant multiple of the standard deviation of the parameter.

15. An apparatus in accordance with Claim 12 wherein said upper limit is an average value of the parameter plus a predetermined constant and said lower limit is an average value of the parameter minus a predetermined constant.

16. An apparatus in accordance with Claim 12 wherein said upper limit and said lower limit are functions of a median value of said parameter.

17. An apparatus in accordance with Claim 12 wherein said upper limit and said lower limit are functions of a mode of sampled values of said parameter.

18. An apparatus in accordance with Claim 10 wherein the industrial process includes at least one apparatus selected from the group consisting of a gas turbine engine, a steam turbine, an electric generator, an electric motor, a pump, a gearbox, and bearings, and said parameter is selected from the group consisting of pressure, temperature, position, acceleration, velocity, power, current, and fluid flow.

19. A medium having machine-readable instructions recorded thereon that are configured to instruct a computer to:

input a sensed parameter of an industrial process, said parameter varying over time;

determine at least one parameter limit, said at least one parameter limit being a function of said parameter and varying over time;

compare said parameter to said at least one parameter limit; and

indicate an alarm condition when said parameter is outside of a bound set by said at least one parameter limit at a time when said parameter is compared to said at least one parameter limit.

20. A medium in accordance with Claim 19 wherein said at least one parameter limit comprises an upper limit and a lower limit.

21. A medium in accordance with Claim 20 further having recorded thereon instructions configured to instruct the computer to buffer said parameter use a time-delayed value of said parameter to compare said parameter to said at least one parameter limit.

22. A medium in accordance with Claim 21 wherein said upper limit is an average value of the parameter plus a predetermined constant multiple of a standard deviation of the parameter, and said lower limit is the average value of the parameter minus the predetermined constant multiple of the standard deviation of the parameter.

23. A medium in accordance with Claim 21 wherein said upper limit is an average value of the parameter plus a predetermined first constant plus a predetermined second constant multiple of a standard deviation of the parameter, and said lower limit is the average value of the parameter minus the predetermined first constant plus the predetermined second constant multiple of the standard deviation of the parameter.

24. A medium in accordance with Claim 21 wherein said upper limit is an average value of the parameter plus a predetermined constant and said lower limit is an average value of the parameter minus a predetermined constant.

25. A medium in accordance with Claim 21 wherein said upper limit and said lower limit are functions of a median value of said parameter.

26. A medium in accordance with Claim 21 wherein said upper limit and said lower limit are functions of a mode of sampled values of said parameter.

27. A medium in accordance with Claim 19 wherein the industrial process includes at least one apparatus selected from the group consisting of a gas turbine engine, a steam turbine, an electric generator, an electric motor, a pump, a gearbox, and bearings, and said parameter is selected from the group consisting of pressure, temperature, position, acceleration, velocity, power, current, and fluid flow.

28. A method for indicating an alarm condition in an industrial process, said method comprising:

measuring a parameter of the industrial process, said parameter varying over time;

latching said parameter and buffering said latched parameter in a FIFO (first-in, first-out) buffer;

determining statistical functions of values of said buffered parameter stored in said FIFO buffer;

utilizing said determined statistical functions to determine one or more alert limits;

comparing value of the parameter to said one or more alert limits; and

indicating an alarm dependent upon said parameter being outside a bound set by the one or more alert limits.

29. A method in accordance with Claim 28 wherein said comparing the value of the parameter to said one or more alert limits comprises comparing a present value of the parameter to the alert limits.

30. A method in accordance with Claim 28 wherein said comparing the value of the parameter to said one or more alert limits comprises comparing a latched value of the parameter to the alert limits.

31. A method in accordance with Claim 28 wherein said indicating an alarm dependent upon said parameter being outside a bound set by the one or more alert limits further comprises determine whether the parameter is outside said bound for a sufficiently long time to indicate an alarm.

32. A method in accordance with Claim 31 further comprising indicating a severity level of the alarm, the severity level being dependent upon the length of time the parameter is outside said bound.

33. A method in accordance with Claim 28 wherein said comparing the value of the parameter to said one or more alert limits further comprises inhibiting an alarm if a valid sample count of parameter values buffered in the FIFO is less than a predetermine value.

34. An apparatus for indicating an alarm condition in an industrial process, said apparatus configured to:

latch a varying parameter value of the industrial process and buffer successive latched parameter values in a FIFO (first-in, first-out) buffer;

determine statistical functions of values of said buffered parameter stored in said FIFO buffer;

utilize said determined statistical functions to determine one or more alert limits;

compare value of the parameter to said one or more alert limits; and

indicate an alarm dependent upon said parameter being outside a bound set by the one or more alert limits.

35. An apparatus in accordance with Claim 34 wherein to compare the value of the parameter to said one or more alert limits, said apparatus is configured to compare a present value of the parameter to the alert limits.

36. An apparatus in accordance with Claim 34 wherein to compare the value of the parameter to said one or more alert limits, said apparatus is configured to compare a latched value of the parameter to the alert limits.

37. An apparatus in accordance with Claim 34 wherein to indicate an alarm dependent upon said parameter being outside a bound set by the one or more alert limits, said apparatus is further configured to determine whether the parameter is outside said bound for a sufficiently long time to indicate an alarm.

38. An apparatus in accordance with Claim 37 further configured to indicate a severity level of the alarm, the severity level being dependent upon the length of time the parameter is outside said bound.

39. An apparatus in accordance with Claim 34 wherein to compare the value of the parameter to said one or more alert limits, said apparatus is further configured to inhibit an alarm if a valid sample count of parameter values buffered in the FIFO is less than a predetermine value.

40. A medium having recorded thereon machine-readable instructions configured to instruct a computer to:

latch a varying parameter value of an industrial process and buffer successive latched parameter values in a FIFO (first-in, first-out) buffer;

determine statistical functions of values of said buffered parameter stored in said FIFO buffer;

utilize said determined statistical functions to determine one or more alert limits;

compare value of the parameter to said one or more alert limits; and

indicate an alarm dependent upon said parameter being outside a bound set by the one or more alert limits.

41. A medium in accordance with Claim 40 wherein to compare the value of the parameter to said one or more alert limits, said instructions are configured to instruct a computer to compare a present value of the parameter to the alert limits.

42. A medium in accordance with Claim 40 wherein to compare the value of the parameter to said one or more alert limits, said instructions are configured to instruct a computer to compare a latched value of the parameter to the alert limits.

43. A medium in accordance with Claim 40 wherein to indicate an alarm dependent upon said parameter being outside a bound set by the one or more alert limits, said instructions are further configured to instruct a computer to determine whether the parameter is outside said bound for a sufficiently long time to indicate an alarm.

44. A medium in accordance with Claim 43 further having instructions recorded thereon that are configured to instruct a computer to indicate a severity level of the alarm, the severity level being dependent upon the length of time the parameter is outside said bound.

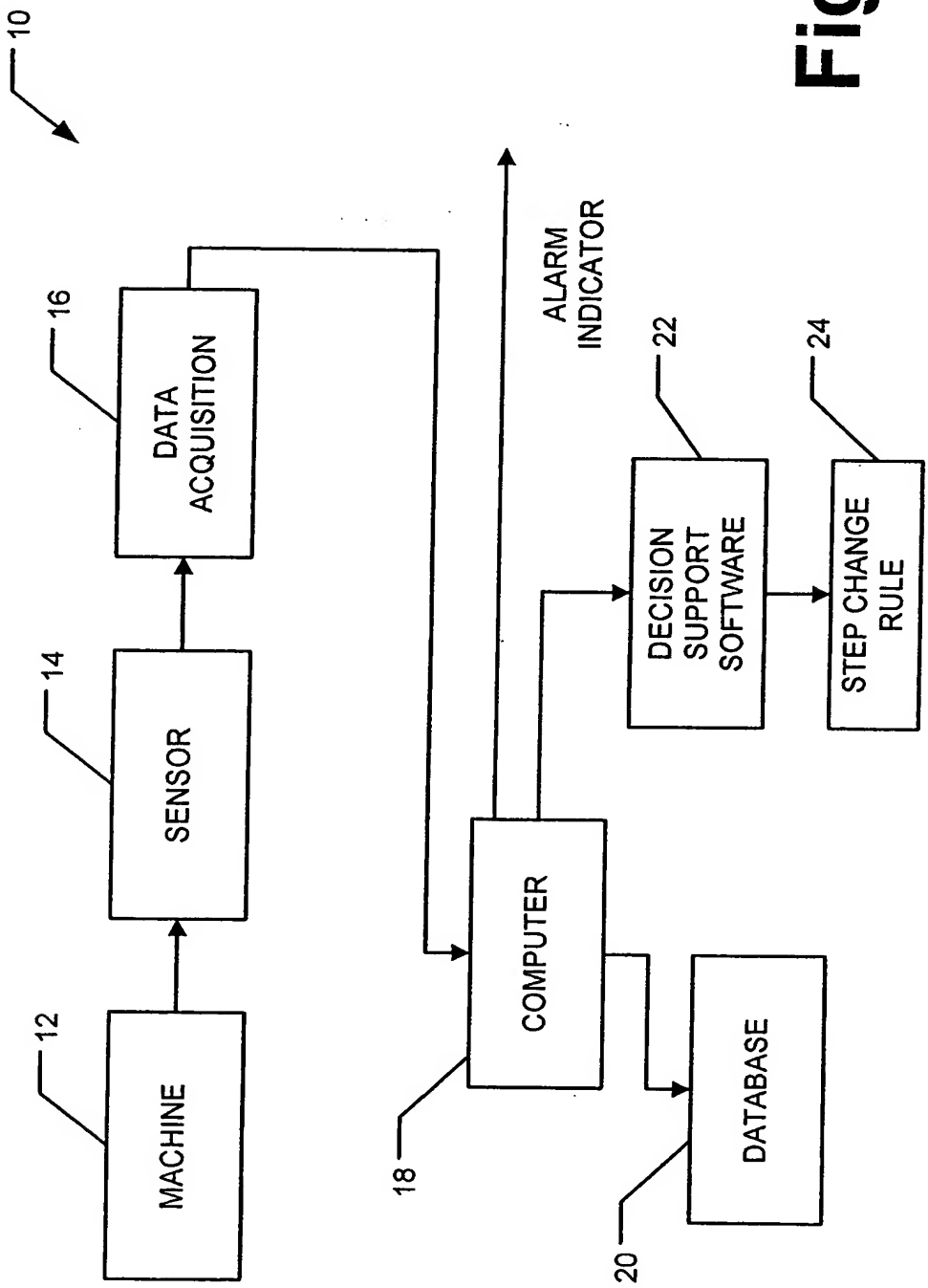
45. A medium in accordance with Claim 40 wherein to compare the value of the parameter to said one or more alert limits, said instructions are further configured to instruct the computer to inhibit an alarm if a valid sample count of parameter values buffered in the FIFO is less than a predetermine value.

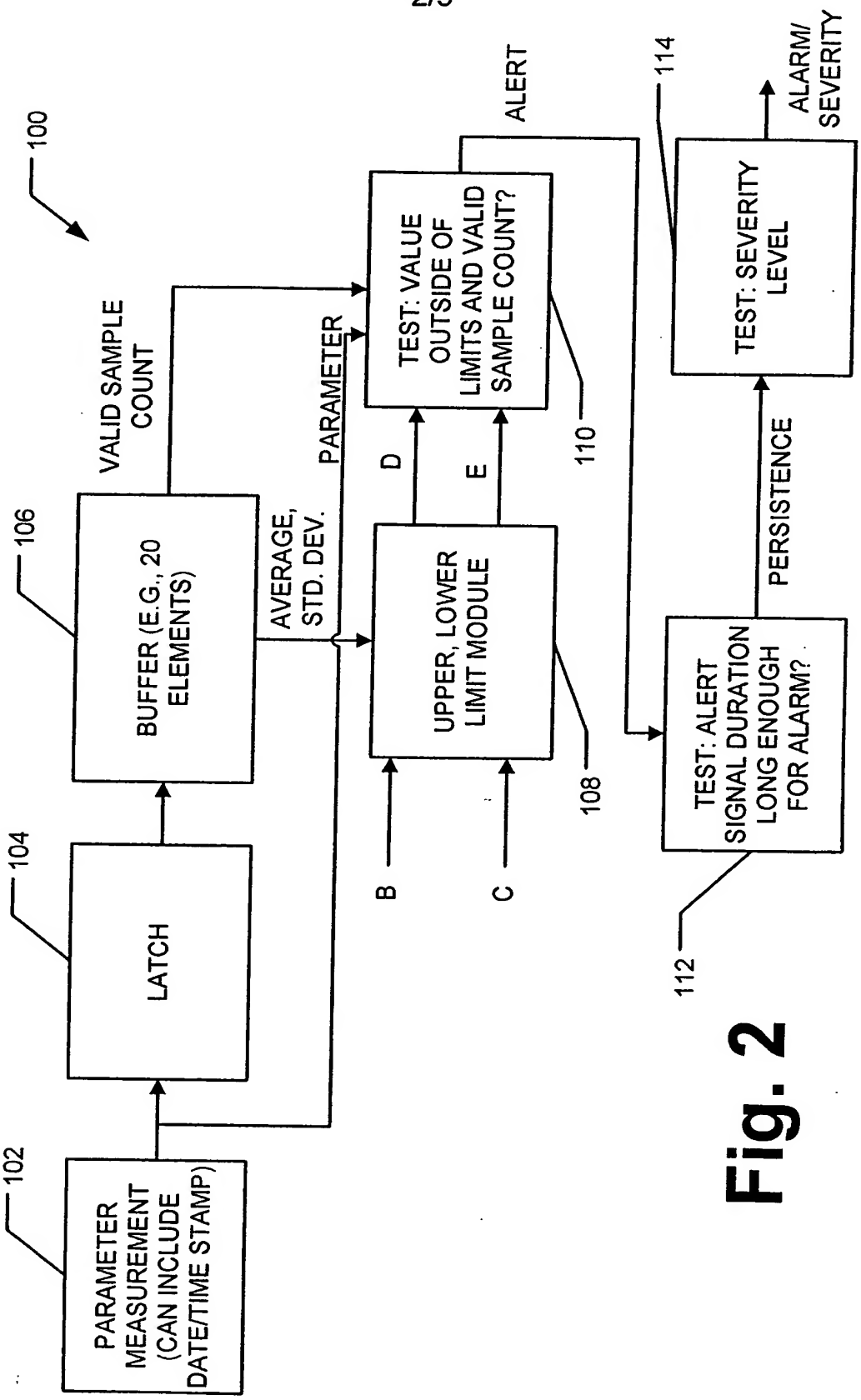
METHODS AND APPARATUS FOR PROVIDING ALARM NOTIFICATION

ABSTRACT OF THE DISCLOSURE

A method for indicating an alarm condition in an industrial process includes measuring a parameter of the industrial process that varies over time and determining at least one parameter limit as a function of the parameter and also varying over time. The method further includes comparing the parameter to the parameter limit or limits and indicating an alarm condition when the parameter is outside of a bound set by the parameter limit or limits when the parameter is compared to the parameter limit or limits.

Fig. 1

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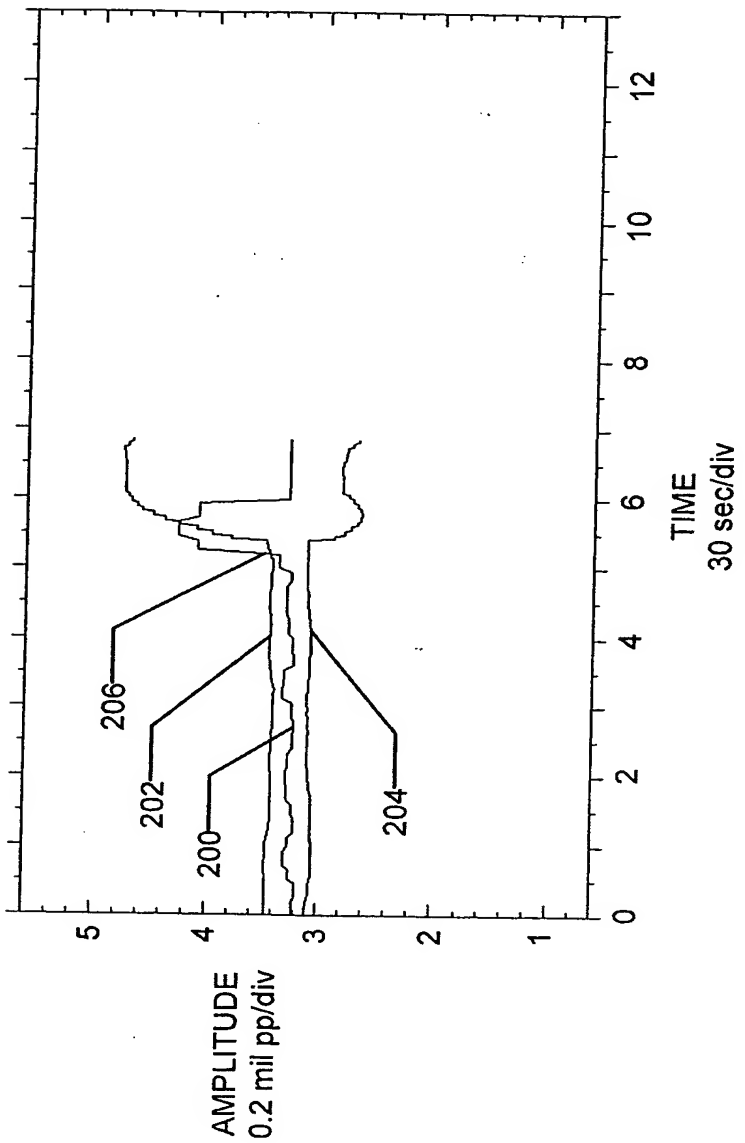
102
PARAMETER MEASUREMENT (CAN INCLUDE DATE/TIME STAMP)
104
LATCH
106
BUFFER (E.G., 20 ELEMENTS)
VALID SAMPLE COUNT
AVERAGE, STD. DEV.
PARAMETER
B
C
D
E
108
UPPER, LOWER LIMIT MODULE
110
TEST: VALUE OUTSIDE OF LIMITS AND VALID SAMPLE COUNT?
ALERT
112
TEST: ALERT SIGNAL DURATION LONG ENOUGH FOR ALARM?
PERSISTENCE
114
TEST: SEVERITY LEVEL
ALARM/ SEVERITY

Fig. 2


206
202
200
204
AMPLITUDE
0.2 mil pp/div
TIME
30 sec/div
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2
4
6
8
10
12
1
2
3
4
5

Fig. 3

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DECLARATION AND POWER OF ATTORNEY	Attorney Docket No. 145512

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **METHODS AND APPARATUS FOR PROVIDING ALARM NOTIFICATION,**

the specification of which:

(check one) ☒ is attached hereto.
☐ was filed on _____ as Application Serial No. _____,
and was amended on _____.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119 (a)-(d) or (f) or 365(b) of any foreign application(s) for patent or inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below, and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED	CERTIFIED COPY ATTACHED
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s), or 365(c) of any PCT International application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose material information as defined in 37 CFR §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. PARENT APPLICATION OR PCT PARENT NUMBER	PARENT FILING DATE (day, month, year)	STATUS (patent and number, pending, abandoned)

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

APPLICATION NUMBER(S)	FILING DATE (day, month, year)

_____ Additional provisional application numbers are listed on a supplemental priority sheet attached hereto.

DECLARATION AND POWER OF ATTORNEY	Attorney Docket No. 145512

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

James E. McGinness (Reg. No. 33,260) of GE Nuclear Energy, P.O. Box 780, 3901 Castle Hayne Road, M/CA11, Wilmington, NC 28,401; Ernest G. Cusick (Reg. No. 39,476) of General Electric Company, 1 River Road, Bldg. 37, 5th Floor, Schenectady, New York 12345; Frank A. Landgraff (Reg. No. 36,853), Lisa Moyles (Reg. No. 40,737), and Shawnell Williams (Reg. No. 36,853), all of General Electric Company, 4200 Wildwood Parkway, Atlanta, Georgia 30339; Henry J. Policinski (Reg. No. 26,621), Scott R. Hayden (Reg. No. 41,821), and James W. Mitchell (Reg. No. 25,602), all of General Electric Company, 3135 Easton Turnpike, Fairfield, CT 06431; John S. Beulick (Reg. No. 33,338), Patrick W. Rasche (Reg. No. 37,916), Dean D. Small (Reg. No. 34,730), Robert B. Reeser III (Reg. No. 45,548), Thomas M. Fisher (Reg. No. 47,564), Bruce T. Atkins (Reg. No. 43,476), Daniel M. Fitzgerald (Reg. No. 38,880), Michael Tersillo (Reg. No. 42,180), William J. Zychlewicz (Reg. No. 51,366), Rozell Williams, Jr., (Reg. No. 44,403), Evan R. Sotiriou (Reg. No. 46,247), Alan L. Cassel (Reg. No. 35,842), and Jay J. Hoette (Reg. No. 50,666); all of Armstrong Teasdale LLP, One Metropolitan Square, St. Louis, MO 63102.

Send Correspondence to:	Direct Telephone Calls To:
John S. Beulick Armstrong Teasdale LLP One Metropolitan Square, Suite 2600 St. Louis, MO 63102	John S. Beulick 314-621-5070

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application and any patent issued thereon.

SOLE INVENTOR:

Full Name: Nathan Bowman Littrell

Signature: [signature] Date: 14 Apr 2004

Residence: Gardnerville, Nevada

Citizenship: US

Post Office Address: 1914 Cutter Lane, Gardnerville, Nevada 89410

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(Rev. 6-93)
OMB No. 0651-0011 (exp. 4/94)

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Patent and Trademark Office

Tab settings

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1. Name of conveying party(ies):

Nathan Bowman Littrell

Additional name(s) of conveying party(ies) attached Yes X No

2. Name and address of receiving party(ies)

Name: General Electric Company

Internal Address:

Street Address: 1 River Road

City: Schenectady State: NY ZIP: 12345

Additional name(s) & address(es) attached? Yes X No

3. Nature of conveyance:

[X] Assignment
[ ] Merger
[ ] Security Agreement
[ ] Change of Name
[ ] Other

Execution Date: April 14, 2004

4. Application number(s) or patent number(s):

If this document is being filed together with a new application, the execution date of the application is: April 14, 2004

A. Patent Application No.(s)

B. Patent No.(s)

Additional numbers attached? Yes X No

5. Name and address of party to whom correspondence concerning document should be mailed:

Name: John S. Beulick

Internal Address: Armstrong Teasdale, LLP.

Street Address: One Metropolitan Sq. Suite 2600

City: St. Louis State: MO ZIP: 63102

6. Total number of applications and patents involved: 1

7. Total fee (37 CFR 3.41).....$ 40.00

[ ] Enclosed

[X] Authorized to be charged to deposit account

8. Deposit account number:

01-2384

(Attach duplicate copy of this page if paying by deposit account)

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9. Statement and signature.

To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Alan L. Cassel, Reg. No. 35,842	Alan Cassel	April 19, 2004
	Signature	Date

Total number of pages including cover sheet, attachments, and document: 3

Mail documents to be recorded with required cover sheet information to:
Commissioner of Patents & Trademarks, Box Assignments
Washington, D.C. 20231

ASSIGNMENT	Attorney Docket No. 145512

In accordance with obligations entered into pursuant to an Employee Innovation and Proprietary Information Agreement or other agreement and/or goods and valuable consideration, of which I acknowledge receipt, I, **NATHAN BOWMAN LITTRELL**, of **1914 Cutter Lane, Gardnerville, Nevada 89410**, sell and assign to General Electric Company, a New York Corporation, having an address at 1 River Road, Schenectady, New York 12345, USA, (hereinafter referred to as "Company"), its successors and assigns, my entire respective right, title and interest in and to the invention and improvements invented and originated by me and as described in the application for United States Patent currently entitled **METHODS AND APPARATUS FOR PROVIDING ALARM NOTIFICATION, Docket Number 145512** , signed as of even date, and any and all applications for patent and patents therefrom in any and all countries, including all divisions, continuations, reexaminations and reissues thereof, and all rights of priority resulting from the filing of said United States application, and authorize and request any official whose duty it is to issue patents, to issue any patent on said inventions and improvements or resulting therefrom to said Company, or its successors or assigns and agree that on request and without further consideration, but at the expense of said Company, I will communicate to said Company or its representatives or nominees any facts known to me respecting said inventions and improvements and testify in any legal proceeding, sign all lawful papers, execute all divisional, continuation, reexamination and reissue applications, make all rightful oaths and generally do everything possible to aid said Company, its successors, assigns, and nominees to obtain and enforce proper patent protection for said invention and its improvements in all countries.

ASSIGNMENT	Attorney Docket No. 145512

Signed at town of Minden, State of Nevada, this 14 day of April, 2004.

NATHAN BOWMAN LITTRELL

Witnessed by:

Witness Signature and Date 04/14/04

ALEXEI PETCHENEV
Printed Name of Witness

Witness Signature and Date 4/14/04

Jeremy Williams
Printed Name of Witness

STATE OF Nevada)
) ss.
COUNTY OF Douglas)

This 14th day of April, 2004, before me personally came the above-named NATHAN BOWMAN LITTRELL, to me personally known as the individual who executed the foregoing assignment, who acknowledged to me that he executed the same of his own free will for the purposes therein set forth.

Notary Public

My Commission Expires: July 1, 2004

(Seal)

EVELYN FINCH
Notary Public - State of Nevada
Appointment Recorded in County of Douglas
My Appointment Expires July 1, 2004
00-64002-5

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PTO/SB/08A (08-00)

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 1 of 1

Complete if Known	
Application Number	
Filing Date	April 19, 2004
First Named Inventor	Nathan Bowman Littrell
Group Art Unit	
Examiner Name	
Attorney Docket Number	145512

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	U.S. Patent Document Number	Kind Code[2] (if known)	Name of Patentee or Applicant Of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	AA	6,684,265	B2	Graf	01-27-2004	
	AB	6,678,635	B2	Tovinkere et al.	01-13-2004	
	AC	6,599,028	B1	Shu et al.	07-29-2003	
	AD	6,505,475	B1	Zugibe et al.	01-14-2003	
	AE	2002/0072882	A1	Kruger et al.	06-13-2002	
	AF	2002/0010563	A1	Ratteree et al.	01-24-2002	
	AG	6,181,975	B1	Gross et al.	01-30-2001	
	AH	5,978,525		Shu et al.	11-02-1999	
	AI	5,764,509		Gross et al.	06-09-1998	
	AJ	5,089,978		Lipner et al.	02-18-1992	
	AK	4,738,147		Tomlin	04-19-1988	
	AL	4,403,297		Tivy	09-06-1983	
	AM	4,180,860		Driscoll et al.	12-25-1979	
	AN					
	AO					
	AP					
	AQ					
	AR					
	AS					
	AT					
	AU					

Examiner Signature		Date Considered:	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Unique citation designation number. [2] See Attached Kinds of U.S. Patent Documents. [3] Enter Office that issued the document, by the two-letter code (WSIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must preceded the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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145512
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Nathan Bowman Littrell	:	
	:	Art Unit:
Serial No.:	:	
	:	Examiner:
Filed: April 19, 2004	:	
	:	
For: METHODS AND APPARATUS FOR PROVIDING ALARM NOTIFICATION	:	

PRELIMINARY AMENDMENT

Hon. Assistant Commissioner for Patents
Washington, D.C. 20231

Prior to examination, please amend the above-identified patent application as follows:

AMENDMENTS TO THE SPECIFICATION

Please replace paragraph [0013] with the following amended paragraph:

[0013] A technical effect of some configurations ~~Some configurations~~ of the present invention is to track a measurand (e.g., vibration magnitude or phase) and, using the measurand, generate a result or raise an alarm when one or more configurable criteria are met (e.g., a statistically defined step change of the measurand). ~~The invention also~~ An additional technical effect of the present invention is to provide ~~provides~~ one or more time based criteria to qualify the data before raising an alarm. Some configurations permit a user to add additional preconditions to the rule to qualify data before raising an alarm. As used herein, a "measurand" is a measurable parameter of an industrial process.

Please replace paragraph [0023] with the following amended paragraph:

[0023] Thus, in some configurations 100 of the present invention and referring to Figure 2, a technical effect of the present invention is achieved by a parameter measurement 102 ~~is latched~~ being latched by latch 104 at suitable intervals, e.g., once every four seconds, or at any other interval suitable for observing and monitoring the industrial process. Latch 104 feeds a FIFO (first-in, first-out) buffer 106, which holds a predetermined number of values of the latched parameter. For example, and not by way of limitation, some configurations of the present invention include a 20 element FIFO, which holds the last 20 latched values of the parameter. Other configurations hold a different number of latched values, and in some configurations of the present invention, the size of FIFO buffer 106 is configurable to allow tuning of the sensitivity to sudden spikes in the parameter value. (For example, a longer buffer is less sensitive to short spikes in the parameter value.) Some configurations of the present invention determine one or more statistical functions (e.g., standard deviation and average) of the latched values for each interval and provide this information to a limit module 108, which utilizes the one or more determined statistical functions to determine one or more alert limits. Module 108 may also

utilize configurable inputs, as described in conjunction with the various equations disclosed above. In some configurations of the present invention, the statistical functions and alert limits are redetermined each time a new value of the parameter is latched and shifted into buffer 106. Also, in some configurations, the statistical values are not necessarily standard deviation and mean, but may include other suitable statistical measures, such as median or mode, or another measure of parameter variance.

Remarks

In the specification, paragraphs [0013] and [0023] have been amended to effect minor editorial changes.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully Submitted,

Alan L. Cassel
Registration No. 35,842
ARMSTRONG TEASDALE LLP
One Metropolitan Square, Suite 2600
St. Louis, Missouri 63102-2740
(314) 621-5070

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Attorney Docket No.: 145512 (17851-105)
Applicant: Nathan Bowman Littrell
Serial No.:
Filed: April 19, 2004
For: Methods and Apparatus for Providing Alarm Notification

Enclosed:

- Utility Patent Application Transmittal (1 page)
- Fee Transmittal (1 page, in duplicate)
- Application consisting of: Specification (10 pages); Claims (8 pages); Abstract (1 page)
- Formal Drawings (3 sheets)
- Declaration of Power of Attorney (2 pages)
- Recordation Form Cover Sheet (1 page) (in duplicate)
- Assignment (2 pages)
- IDS Form 1449 (1 page)
- Preliminary Amendment (4 apges)
- Return Post Card

ALC/cma
Mailed: April 19, 2004
Express Mail No.: EL 977940239 US

UNITED STATES POSTAL SERVICE

Express Mail No. 9779405170S

Track & Confirm

Shipment Details

You entered EL97 7940 239U S

Your item was delivered at 9:21 am on April 20, 2004 in ALEXANDRIA, VA 22313 to PATENT OFFICE. The item was signed for by M BOSTON.

Here is what happened earlier:

- ARRIVAL AT UNIT, April 20, 2004, 7:32 am, DULLES, VA 20102
- ENROUTE, April 19, 2004, 8:10 pm, SAINT LOUIS, MO 63145
- ACCEPTANCE, April 19, 2004, 4:47 pm, SAINT LOUIS, MO 63101

Track & Confirm

Enter label number:

Track & Confirm FAQs

Notification Options

- **Track & Confirm by email** What is this? Go>
- **Request Proof of Delivery** What is this? Go>

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COPY

Express Mail No. 977940573US

UNITED STATES POSTAL SERVICE™

Date: 08/02/2004

Fax Transmission To: CHRIS AXLEY
Fax Number: 314-621-5065

Dear CHRIS AXLEY:

The following is in response to your 08/02/2004 request for delivery information on your Express Mail item number EL977940239US. The delivery record shows that this item was delivered on 04/20/2004 at 09:21 AM in ALEXANDRIA, VA 22313 to M BOSTON. The scanned image of the recipient information is provided below.

Signature of Recipient: Delivery Section
Mary Boston
P & T OFFICE

Address of Recipient: P. O. BOX 1450
Alexandria, VA 22313

Thank you for selecting the Postal Service for your mailing needs. If you require additional assistance, please contact your local Post Office or postal representative.

Sincerely,

United States Postal Service